

APPENDIX B: MARINE MAMMALS STRIKE PROBABILITY ASSESSMENT

Introduction

An approach was used to determine the expected number of marine animals that could be struck by the separation and jettison or drop of various spent stages and payload fairings from commercial launches in the U.S. For this approach, the data were based on the projected 1998 commercial launch rate, because it was the highest annual launch rate.

Assumptions

Various assumptions were applied to the 1998 launch rate data to estimate the number of items jettisoned/dropped that could potentially hit marine animals. The highest launch rate occurs during 1998 with a total of 50 launches. Each number of the total is a worst case for the payload capacity size (e.g., a Delta II is used as an example of an intermediate rocket, because more parts are jettisoned than an Atlas). Conservative total launch numbers have been developed for each of the four payload capacity types.

- Small, Land-based - 7
- Small, Air-based - 5
- Medium/Intermediate - 31
- High - 7

The launches were further separated into launches over the Atlantic Ocean and over the Pacific Ocean. Thus, the launch total was divided in half and distributed as noted in Table B-1. Because there is an odd number for each type of launches, the number for each type was divided in half with one ocean having one more launch than the other (e.g., Small, Land-based (total: 7) was projected to be 4 over the Atlantic and 3 over the Pacific). The launches were distributed so that the total for each ocean was 25 launches.

During the launch process, up to four stages, up to nine SRMs, and a payload fairing can be jettisoned/dropped. The four stages are: Stage 0, Stage 1, Stage 2, and Stage 3. The following assumptions were made:

- None of the stages or payload fairing are burned up or broken apart during the descent.
- All the stages and payload fairing (including Stage 3 parts) fall back to the Earth intact, while taking into consideration the widest possible trajectory over the oceans.
- A jettisoned payload fairing breaks up into three equal pieces upon impact with the ocean surface.
- For each applicable stage, there is one part jettisoned, however it is not the case for the Medium/Intermediate and High capacity launches for Stage 0.
 - Nine SRMs are jettisoned during ascent on every Delta II vehicle for a Medium/Intermediate Capacity launch.

- Two SRMs are jettisoned during ascent on every Titan III vehicle for a High Capacity launch.

These assumptions are applied to the probability assessment to obtain the worst case scenario for predicting contact between jettisoned spacecraft and marine animals during the launch period. For example, it is conservative to assume that all the stages and payload fairing fall back to the Earth intact, because this is the breakup configuration that appears to have the most potential for damage to marine mammals (e.g., several very large pieces have the highest potential for inflicting damage to marine mammals than many smaller pieces, so the breakup configuration involving the most very large pieces was used).

Methodology

The various stages and payload fairing that are jettisoned have a certain length which is used to calculate an “effective” area. The effective area for any one component is the region within which any marine animal present will be struck. When the stage-specific effective areas (in square kilometers) are multiplied by the species-specific densities (number of animals per square kilometer), one obtains the expected (average) number of animals for any one species that would be in the effective area of any one stage of each separation. Multiplying those numbers by the total number of components of each stage or payload fairing to be jettisoned in a year yields the total expected number of animals of each species that would be hit. Summing over the different stages and the different species of marine animals yields the total expected number of marine animals struck. These calculations and results are shown in Extended Tables B-2 and B-3 at the end of this appendix.

This approach makes some simplifying assumptions which in most cases are conservative and tend to over-estimate the expected number of animals struck. The main assumptions include:

- The entire range of any given species is considered to be susceptible to the stages and payload fairing releases. This assumption is implicit in using the average densities for the calculations, because it is assumed that all the animals are at risk from any one component. This approach ignores the fact that, in the stage’s hazard area, there may be no animals of a given species present at the time of a stage release. In order to simplify the analysis, this assumption also ignores the possibility that there may be more than one animal hit by a single stage.
- This analysis ignores the possibility that effective areas of two or more stages jettisoned during a single launch may overlap, potentially overestimating the total effective area.
- The analysis assumes a uniform density for all marine animals throughout the respective ocean. For the Atlantic Ocean, densities are derived from the highest seasonal density in a continental shelf area (which has higher densities than the open ocean for many species, especially migratory ones such as turtles).
- The fractional probabilities are summed across all marine species. So, for example, if a probability of hit was 0.2 for 5 different species, the methodology would report that as 1.0 animals. Note that the highest probability for an individual species is less than

0.02. Thus, by combining improbable events for several species, the probability of a “hit” is inflated.

Given the assumptions listed above, this approach can estimate the expected (average) number of animals struck for any combination of stages or payload fairing, species of concern, and numbers of stages jettisoned.

Conclusions

The results are documented in Table B-4 and B-5. They show that the total expected number of marine animals struck is potentially 0.078 annually in the Atlantic Ocean and 0.297 annually in the Pacific Ocean. Therefore, the total number of animals at risk is less than 0.4 annually. These results signify that the risk to marine animals is extremely low from launch activities in the U.S.

TABLE B-1
DISTRIBUTION OF JETTISONED MATERIAL INTO ATLANTIC AND PACIFIC OCEAN

Rockets	Stage 0		Stage 1		Stage 2		Stage 3		Payload Fairing (# per launch)		Total Number of Objects
Length (effective radius)	ft	Km	ft	km	ft	km	ft	km	ft	km	
Small Land	29.59	0.009019	29.1	0.00887	8.92	0.002719	4.39	0.001338	5.65	0.001722	
Small Air	---	---	29.1	0.00887	11.7	0.003566	4.39	0.001338	14.5	0.00442	
Medium/Intermediate	42.5	0.012954	85.6	0.026091	19.6	0.005974	6.7	0.002042	26	0.007925	
High	90.4	0.027554	78.6	0.023957	32.7	0.009967	11	0.003353	42.6	0.012984	
Area (km²)											
Small Land	---	0.000255	---	0.000247	---	2.32E-05	---	5.62E-06	---	9.31E-06	
Small Air	---	---	---	0.000247	---	3.99E-05	---	5.62E-06	---	6.13E-05	
Medium/Intermediate	---	0.000527	---	0.002138	---	0.000112	---	1.31E-05	---	0.000197	
High	---	0.002384	---	0.001802	---	0.000312	---	3.53E-05	---	0.000529	
Number/year	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific	
Small Land (7 launches)	4	3	4	3	4	3	4	3	12	9	7 per launch 49 total
Small Air (5 launches)	2	3	2	3	2	3	2	3	6	9	6 per launch 30 total
Medium/Intermediate (31 launches)	135a	144a	15	16	15	16	15	16	45	48	15 per launch 465 total
High (7 launches)	8b	6b	4	3	4	3	4	3	12	9	8 per launch 56 total

b: Two SRMs on every Titus III vehicle are jettisoned during ascent

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN

SMALL LAND (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area (sq km)	One Component	Total (4/vr)	Area (sq km)	One Component	Total (4/vr)	Area (sq km)	One Component	Total (4/vr)
Atlantic spotted dolphin	1.28E-03	2.554E-04	3.269E-07	1.308E-06	2.470E-04	3.162E-07	1.265E-06	2.321E-05	2.971E-08	1.188E-07
Atlantic white-sided dolphin	1.19E-02	2.554E-04	3.039E-06	1.216E-05	2.470E-04	2.939E-06	1.176E-05	2.321E-05	2.762E-07	1.105E-06
Blue whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Bottlenose dolphin	4.59E-02	2.554E-04	1.172E-05	4.689E-05	2.470E-04	1.134E-05	4.535E-05	2.321E-05	1.065E-06	4.261E-06
Common dolphin	1.78E-01	2.554E-04	4.546E-05	1.818E-04	2.470E-04	4.397E-05	1.759E-04	2.321E-05	4.131E-06	1.653E-05
Cuvier's beaked whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Dwarf sperm whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Fin whale	1.23E-02	2.554E-04	3.141E-06	1.257E-05	2.470E-04	3.038E-06	1.215E-05	2.321E-05	2.855E-07	1.142E-06
Harbor porpoise	1.56E-03	2.554E-04	3.984E-07	1.594E-06	2.470E-04	3.853E-07	1.541E-06	2.321E-05	3.621E-08	1.448E-07
Humpback whale	4.98E-04	2.554E-04	1.272E-07	5.088E-07	2.470E-04	1.230E-07	4.920E-07	2.321E-05	1.156E-08	4.623E-08
Long-finned pilot whale	6.51E-02	2.554E-04	1.663E-05	6.651E-05	2.470E-04	1.608E-05	6.432E-05	2.321E-05	1.511E-06	6.044E-06
Mesoplodon spp. beaked whales	4.22E-04	2.554E-04	1.078E-07	4.311E-07	2.470E-04	1.042E-07	4.169E-07	2.321E-05	9.795E-09	3.918E-08
Minke whale	5.54E-04	2.554E-04	1.415E-07	5.660E-07	2.470E-04	1.368E-07	5.474E-07	2.321E-05	1.286E-08	5.143E-08
North Atlantic right whale	2.77E-04	2.554E-04	7.075E-08	2.830E-07	2.470E-04	6.842E-08	2.737E-07	2.321E-05	6.429E-09	2.572E-08
Pygmy killer whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Pygmy sperm whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Risso's dolphin	7.00E-02	2.554E-04	1.788E-05	7.151E-05	2.470E-04	1.729E-05	6.916E-05	2.321E-05	1.625E-06	6.499E-06
Sei whale	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Short-finned pilot whale	6.51E-02	2.554E-04	1.663E-05	6.651E-05	2.470E-04	1.608E-05	6.432E-05	2.321E-05	1.511E-06	6.044E-06
Sperm whale	1.24E-03	2.554E-04	3.167E-07	1.267E-06	2.470E-04	3.063E-07	1.225E-06	2.321E-05	2.878E-08	1.151E-07
Striped dolphin	2.92E-02	2.554E-04	7.458E-06	2.983E-05	2.470E-04	7.212E-06	2.885E-05	2.321E-05	6.777E-07	2.711E-06
Green sea turtle	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Kemp's Ridley sea turtle	1.71E-04	2.554E-04	4.367E-08	1.747E-07	2.470E-04	4.224E-08	1.689E-07	2.321E-05	3.969E-09	1.588E-08
Leatherback sea turtle	1.88E-03	2.554E-04	4.802E-07	1.921E-06	2.470E-04	4.644E-07	1.857E-06	2.321E-05	4.363E-08	1.745E-07
Loggerhead sea turtle	5.25E-02	2.554E-04	1.341E-05	5.363E-05	2.470E-04	1.297E-05	5.187E-05	2.321E-05	1.219E-06	4.874E-06
		Totals:	0.000138	0.000551		0.000133	0.000533		0.000013	0.000050

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

SMALL LAND (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Componen	Total (4/yr)	Area (sq km)	One Fairing	Total (12/yr)	One	All
Atlantic spotted dolphin	5.622E-06	7.196E-09	2.878E-08	9.312E-06	1.192E-	1.430E-07	6.919E-07	2.863E-06
Atlantic white-sided dolphin	5.622E-06	6.690E-08	2.676E-07	9.312E-06	1.108E-	1.330E-06	6.432E-06	2.662E-05
Blue whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Bottlenose dolphin	5.622E-06	2.580E-07	1.032E-06	9.312E-06	4.274E-	5.129E-06	2.481E-05	1.027E-04
Common dolphin	5.622E-06	1.001E-06	4.003E-06	9.312E-06	1.658E-	1.989E-05	9.622E-05	3.981E-04
Cuvier's beaked whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Dwarf sperm whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Fin whale	5.622E-06	6.915E-08	2.766E-07	9.312E-06	1.145E-	1.374E-06	6.649E-06	2.751E-05
Harbor porpoise	5.622E-06	8.770E-09	3.508E-08	9.312E-06	1.453E-	1.743E-07	8.432E-07	3.489E-06
Humpback whale	5.622E-06	2.800E-09	1.120E-08	9.312E-06	4.637E-	5.565E-08	2.692E-07	1.114E-06
Long-finned pilot whale	5.622E-06	3.660E-07	1.464E-06	9.312E-06	6.062E-	7.275E-06	3.519E-05	1.456E-04
Mesoplodon spp. beaked whales	5.622E-06	2.372E-09	9.490E-09	9.312E-06	3.930E-	4.716E-08	2.281E-07	9.439E-07
Minke whale	5.622E-06	3.115E-09	1.246E-08	9.312E-06	5.159E-	6.191E-08	2.995E-07	1.239E-06
North Atlantic right whale	5.622E-06	1.557E-09	6.229E-09	9.312E-06	2.579E-	3.095E-08	1.497E-07	6.196E-07
Pygmy killer whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Pygmy sperm whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Risso's dolphin	5.622E-06	3.935E-07	1.574E-06	9.312E-06	6.518E-	7.822E-06	3.784E-05	1.566E-04
Sei whale	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Short-finned pilot whale	5.622E-06	3.660E-07	1.464E-06	9.312E-06	6.062E-	7.275E-06	3.519E-05	1.456E-04
Sperm whale	5.622E-06	6.971E-09	2.789E-08	9.312E-06	1.155E-	1.386E-07	6.703E-07	2.773E-06
Striped dolphin	5.622E-06	1.642E-07	6.566E-07	9.312E-06	2.719E-	3.263E-06	1.578E-05	6.531E-05
Green sea turtle	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Kemp's Ridley sea turtle	5.622E-06	9.614E-10	3.845E-09	9.312E-06	1.592E-	1.911E-08	9.243E-08	3.825E-07
Leatherback sea turtle	5.622E-06	1.057E-08	4.228E-08	9.312E-06	1.751E-	2.101E-07	1.016E-06	4.205E-06
Loggerhead sea turtle	5.622E-06	2.952E-07	1.181E-06	9.312E-06	4.889E-	5.867E-06	2.838E-05	1.174E-04
	Totals:	0.000003	0.000012		0.000005	0.000060	0.000291	0.001206

SMALL AIR (1998)

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area (sq km)	One Component	Total (0/yr)	Area (sq km)	One Component	Total (2/yr)	Area (sq km)	One	Total (2/yr)
Atlantic spotted dolphin	1.28E-03	--	--	--	2.470E-04	3.162E-07	6.323E-07	3.993E-05	5.111E-08	1.022E-07
Atlantic white-sided dolphin	1.19E-02	--	--	--	2.470E-04	2.939E-06	5.879E-06	3.993E-05	4.752E-07	9.503E-07
Blue whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Bottlenose dolphin	4.59E-02	--	--	--	2.470E-04	1.134E-05	2.267E-05	3.993E-05	1.833E-06	3.666E-06
Common dolphin	1.78E-01	--	--	--	2.470E-04	4.397E-05	8.793E-05	3.993E-05	7.108E-06	1.422E-05
Cuvier's beaked whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Dwarf sperm whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Fin whale	1.23E-02	--	--	--	2.470E-04	3.038E-06	6.076E-06	3.993E-05	4.911E-07	9.823E-07
Harbor porpoise	1.56E-03	--	--	--	2.470E-04	3.853E-07	7.706E-07	3.993E-05	6.229E-08	1.246E-07
Humpback whale	4.98E-04	--	--	--	2.470E-04	1.230E-07	2.460E-07	3.993E-05	1.989E-08	3.977E-08
Long-finned pilot whale	6.51E-02	--	--	--	2.470E-04	1.608E-05	3.216E-05	3.993E-05	2.599E-06	5.199E-06
Mesoplodon spp. beaked whales	4.22E-04	--	--	--	2.470E-04	1.042E-07	2.085E-07	3.993E-05	1.685E-08	3.370E-08
Minke whale	5.54E-04	--	--	--	2.470E-04	1.368E-07	2.737E-07	3.993E-05	2.212E-08	4.424E-08
North Atlantic right whale	2.77E-04	--	--	--	2.470E-04	6.842E-08	1.368E-07	3.993E-05	1.106E-08	2.212E-08
Pygmy killer whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Pygmy sperm whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Risso's dolphin	7.00E-02	--	--	--	2.470E-04	1.729E-05	3.458E-05	3.993E-05	2.795E-06	5.590E-06
Sei whale	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Short-finned pilot whale	6.51E-02	--	--	--	2.470E-04	1.608E-05	3.216E-05	3.993E-05	2.599E-06	5.199E-06
Sperm whale	1.24E-03	--	--	--	2.470E-04	3.063E-07	6.126E-07	3.993E-05	4.951E-08	9.903E-08
Striped dolphin	2.92E-02	--	--	--	2.470E-04	7.212E-06	1.442E-05	3.993E-05	1.166E-06	2.332E-06
Green sea turtle	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Kemp's Ridley sea turtle	1.71E-04	--	--	--	2.470E-04	4.224E-08	8.447E-08	3.993E-05	6.828E-09	1.366E-08
Leatherback sea turtle	1.88E-03	--	--	--	2.470E-04	4.644E-07	9.287E-07	3.993E-05	7.507E-08	1.501E-07
Loggerhead sea turtle	5.25E-02	--	--	--	2.470E-04	1.297E-05	2.594E-05	3.993E-05	2.096E-06	4.193E-06
		Totals:	0.000000	0.000000		0.000133	2.663E-04		0.000022	0.000043

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

SMALL AIR (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (2/yr)	Area (sq km)	One Fairing	Total (6/yr)	One	All
Atlantic spotted dolphin	5.622E-06	7.196E-09	1.439E-08	6.133E-05	7.850E-08	4.710E-07	4.530E-07	1.220E-06
Atlantic white-sided dolphin	5.622E-06	6.690E-08	1.338E-07	6.133E-05	7.298E-07	4.379E-06	4.211E-06	1.134E-05
Blue whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Bottlenose dolphin	5.622E-06	2.580E-07	5.161E-07	6.133E-05	2.815E-06	1.689E-05	1.624E-05	4.375E-05
Common dolphin	5.622E-06	1.001E-06	2.001E-06	6.133E-05	1.092E-05	6.550E-05	6.299E-05	1.696E-04
Cuvier's beaked whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Dwarf sperm whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Fin whale	5.622E-06	6.915E-08	1.383E-07	6.133E-05	7.544E-07	4.526E-06	4.353E-06	1.172E-05
Harbor porpoise	5.622E-06	8.770E-09	1.754E-08	6.133E-05	9.567E-08	5.740E-07	5.521E-07	1.487E-06
Humpback whale	5.622E-06	2.800E-09	5.600E-09	6.133E-05	3.054E-08	1.833E-07	1.762E-07	4.746E-07
Long-finned pilot whale	5.622E-06	3.660E-07	7.320E-07	6.133E-05	3.993E-06	2.396E-05	2.304E-05	6.205E-05
Mesoplodon spp. beaked whales	5.622E-06	2.372E-09	4.745E-09	6.133E-05	2.588E-08	1.553E-07	1.493E-07	4.022E-07
Minke whale	5.622E-06	3.115E-09	6.229E-09	6.133E-05	3.398E-08	2.039E-07	1.961E-07	5.280E-07
North Atlantic right whale	5.622E-06	1.557E-09	3.115E-09	6.133E-05	1.699E-08	1.019E-07	9.803E-08	2.640E-07
Pygmy killer whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Pygmy sperm whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Risso's dolphin	5.622E-06	3.935E-07	7.871E-07	6.133E-05	4.293E-06	2.576E-05	2.477E-05	6.672E-05
Sei whale	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Short-finned pilot whale	5.622E-06	3.660E-07	7.320E-07	6.133E-05	3.993E-06	2.396E-05	2.304E-05	6.205E-05
Sperm whale	5.622E-06	6.971E-09	1.394E-08	6.133E-05	7.605E-08	4.563E-07	4.388E-07	1.182E-06
Striped dolphin	5.622E-06	1.642E-07	3.283E-07	6.133E-05	1.791E-06	1.075E-05	1.033E-05	2.783E-05
Green sea turtle	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Kemp's Ridley sea turtle	5.622E-06	9.614E-10	1.923E-09	6.133E-05	1.049E-08	6.292E-08	6.051E-08	1.630E-07
Leatherback sea turtle	5.622E-06	1.057E-08	2.114E-08	6.133E-05	1.153E-07	6.918E-07	6.653E-07	1.792E-06
Loggerhead sea turtle	5.622E-06	2.952E-07	5.903E-07	6.133E-05	3.220E-06	1.932E-05	1.858E-05	5.004E-05
	Totals:	0.000003	0.000006		0.000033	0.000198	0.000191	0.000514

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

MEDIUM/INTERMEDIATE (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area (sq km)	One Component	Total	Area (sq km)	One Component	Total (15/yr)	Area (sq km)	One Component	Total (15/yr)
Atlantic spotted dolphin	1.28E-03	5.269E-04	6.744E-07	9.105E-05	2.138E-03	2.736E-06	4.104E-05	1.121E-04	1.435E-07	2.152E-06
Atlantic white-sided dolphin	1.19E-02	5.269E-04	6.270E-06	8.465E-04	2.138E-03	2.544E-05	3.815E-04	1.121E-04	1.334E-06	2.001E-05
Blue whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Bottlenose dolphin	4.59E-02	5.269E-04	2.418E-05	3.265E-03	2.138E-03	9.811E-05	1.472E-03	1.121E-04	5.145E-06	7.718E-05
Common dolphin	1.78E-01	5.269E-04	9.379E-05	1.266E-02	2.138E-03	3.805E-04	5.707E-03	1.121E-04	1.995E-05	2.993E-04
Cuvier's beaked whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Dwarf sperm whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Fin whale	1.23E-02	5.269E-04	6.481E-06	8.749E-04	2.138E-03	2.629E-05	3.944E-04	1.121E-04	1.379E-06	2.068E-05
Harbor porpoise	1.56E-03	5.269E-04	8.220E-07	1.110E-04	2.138E-03	3.335E-06	5.002E-05	1.121E-04	1.749E-07	2.623E-06
Humpback whale	4.98E-04	5.269E-04	2.624E-07	3.542E-05	2.138E-03	1.064E-06	1.597E-05	1.121E-04	5.583E-08	8.374E-07
Long-finned pilot whale	6.51E-02	5.269E-04	3.430E-05	4.631E-03	2.138E-03	1.392E-04	2.087E-03	1.121E-04	7.298E-06	1.095E-04
Mesoplodon spp. beaked whales	4.22E-04	5.269E-04	2.224E-07	3.002E-05	2.138E-03	9.020E-07	1.353E-05	1.121E-04	4.731E-08	7.096E-07
Minke whale	5.54E-04	5.269E-04	2.919E-07	3.941E-05	2.138E-03	1.184E-06	1.776E-05	1.121E-04	6.210E-08	9.316E-07
North Atlantic right whale	2.77E-04	5.269E-04	1.460E-07	1.970E-05	2.138E-03	5.921E-07	8.881E-06	1.121E-04	3.105E-08	4.658E-07
Pygmy killer whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Pygmy sperm whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Risso's dolphin	7.00E-02	5.269E-04	3.688E-05	4.979E-03	2.138E-03	1.496E-04	2.244E-03	1.121E-04	7.847E-06	1.177E-04
Sei whale	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Short-finned pilot whale	6.51E-02	5.269E-04	3.430E-05	4.631E-03	2.138E-03	1.392E-04	2.087E-03	1.121E-04	7.298E-06	1.095E-04
Sperm whale	1.24E-03	5.269E-04	6.534E-07	8.820E-05	2.138E-03	2.651E-06	3.976E-05	1.121E-04	1.390E-07	2.085E-06
Striped dolphin	2.92E-02	5.269E-04	1.539E-05	2.077E-03	2.138E-03	6.242E-05	9.362E-04	1.121E-04	3.273E-06	4.910E-05
Green sea turtle	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Kemp's Ridley sea turtle	1.71E-04	5.269E-04	9.010E-08	1.216E-05	2.138E-03	3.655E-07	5.483E-06	1.121E-04	1.917E-08	2.875E-07
Leatherback sea turtle	1.88E-03	5.269E-04	9.906E-07	1.337E-04	2.138E-03	4.019E-06	6.028E-05	1.121E-04	2.107E-07	3.161E-06
Loggerhead sea turtle	5.25E-02	5.269E-04	2.766E-05	3.734E-03	2.138E-03	1.122E-04	1.683E-03	1.121E-04	5.885E-06	8.828E-05
		Totals:	0.000284	0.038345		0.001152	0.017284		0.000060	0.000906

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

MEDIUM/INTERMEDIATE (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (15/yr)	Area (sq km)	One Fairing	Total (45/yr)	One	All
Atlantic spotted dolphin	1.136E-05	1.677E-08	2.515E-07	1.972E-04	2.524E-07	1.136E-05	3.823E-06	1.459E-04
Atlantic white-sided dolphin	1.056E-04	1.559E-07	2.338E-06	1.972E-04	2.347E-06	1.056E-04	3.554E-05	1.356E-03
Blue whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Bottlenose dolphin	4.073E-04	6.013E-07	9.019E-06	1.972E-04	9.051E-06	4.073E-04	1.371E-04	5.230E-03
Common dolphin	1.580E-03	2.332E-06	3.498E-05	1.972E-04	3.510E-05	1.580E-03	5.317E-04	2.028E-02
Cuvier's beaked whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Dwarf sperm whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Fin whale	1.092E-04	1.611E-07	2.417E-06	1.972E-04	2.426E-06	1.092E-04	3.674E-05	1.402E-03
Harbor porpoise	1.384E-05	2.044E-08	3.065E-07	1.972E-04	3.076E-07	1.384E-05	4.659E-06	1.778E-04
Humpback whale	4.419E-06	6.524E-09	9.786E-08	1.972E-04	9.821E-08	4.419E-06	1.487E-06	5.675E-05
Long-finned pilot whale	5.777E-04	8.528E-07	1.279E-05	1.972E-04	1.284E-05	5.777E-04	1.944E-04	7.418E-03
Mesoplodon spp. beaked whales	3.745E-06	5.528E-09	8.292E-08	1.972E-04	8.322E-08	3.745E-06	1.260E-06	4.809E-05
Minke whale	4.916E-06	7.257E-09	1.089E-07	1.972E-04	1.092E-07	4.916E-06	1.655E-06	6.313E-05
North Atlantic right whale	2.458E-06	3.629E-09	5.443E-08	1.972E-04	5.462E-08	2.458E-06	8.273E-07	3.156E-05
Pygmy killer whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Pygmy sperm whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Risso's dolphin	6.212E-04	9.170E-07	1.376E-05	1.972E-04	1.380E-05	6.212E-04	2.091E-04	7.976E-03
Sei whale	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Short-finned pilot whale	5.777E-04	8.528E-07	1.279E-05	1.972E-04	1.284E-05	5.777E-04	1.944E-04	7.418E-03
Sperm whale	1.100E-05	1.624E-08	2.437E-07	1.972E-04	2.445E-07	1.100E-05	3.704E-06	1.413E-04
Striped dolphin	2.591E-04	3.825E-07	5.738E-06	1.972E-04	5.758E-06	2.591E-04	8.721E-05	3.327E-03
Green sea turtle	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Kemp's Ridley sea turtle	1.517E-06	2.240E-09	3.360E-08	1.972E-04	3.372E-08	1.517E-06	5.107E-07	1.948E-05
Leatherback sea turtle	1.668E-05	2.463E-08	3.694E-07	1.972E-04	3.707E-07	1.668E-05	5.615E-06	2.142E-04
Loggerhead sea turtle	4.659E-04	6.878E-07	1.032E-05	1.972E-04	1.035E-05	4.659E-04	1.568E-04	5.982E-03
	Totals:	0.000007	0.000106		0.000106	0.004784	0.001610	0.061426

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

HIGH (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area (sq km)	One Component	Total (6/yr)	Area (sq km)	One	Total (3/yr)	Area (sq km)	One Component	Total (3/yr)
Atlantic spotted dolphin	1.28E-03	2.384E-03	3.051E-06	1.831E-05	1.802E-	2.307E-06	6.920E-06	3.119E-04	3.992E-07	1.198E-06
Atlantic white-sided dolphin	1.19E-02	2.384E-03	2.837E-05	1.702E-04	1.802E-	2.145E-05	6.434E-05	3.119E-04	3.712E-06	1.113E-05
Blue whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Bottlenose dolphin	4.59E-02	2.384E-03	1.094E-04	6.565E-04	1.802E-	8.272E-05	2.482E-04	3.119E-04	1.432E-05	4.295E-05
Common dolphin	1.78E-01	2.384E-03	4.243E-04	2.546E-03	1.802E-	3.208E-04	9.624E-04	3.119E-04	5.552E-05	1.666E-04
Cuvier's beaked whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Dwarf sperm whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Fin whale	1.23E-02	2.384E-03	2.932E-05	1.759E-04	1.802E-	2.217E-05	6.650E-05	3.119E-04	3.836E-06	1.151E-05
Harbor porpoise	1.56E-03	2.384E-03	3.719E-06	2.231E-05	1.802E-	2.811E-06	8.434E-06	3.119E-04	4.866E-07	1.460E-06
Humpback whale	4.98E-04	2.384E-03	1.187E-06	7.123E-06	1.802E-	8.975E-07	2.692E-06	3.119E-04	1.553E-07	4.660E-07
Long-finned pilot whale	6.51E-02	2.384E-03	1.552E-04	9.312E-04	1.802E-	1.173E-04	3.520E-04	3.119E-04	2.030E-05	6.091E-05
Mesoplodon spp. beaked whales	4.22E-04	2.384E-03	1.006E-06	6.036E-06	1.802E-	7.605E-07	2.282E-06	3.119E-04	1.316E-07	3.949E-07
Minke whale	5.54E-04	2.384E-03	1.321E-06	7.924E-06	1.802E-	9.984E-07	2.995E-06	3.119E-04	1.728E-07	5.184E-07
North Atlantic right whale	2.77E-04	2.384E-03	6.603E-07	3.962E-06	1.802E-	4.992E-07	1.498E-06	3.119E-04	8.640E-08	2.592E-07
Pygmy killer whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Pygmy sperm whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Risso's dolphin	7.00E-02	2.384E-03	1.669E-04	1.001E-03	1.802E-	1.262E-04	3.785E-04	3.119E-04	2.183E-05	6.550E-05
Sei whale	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Short-finned pilot whale	6.51E-02	2.384E-03	1.552E-04	9.312E-04	1.802E-	1.173E-04	3.520E-04	3.119E-04	2.030E-05	6.091E-05
Sperm whale	1.24E-03	2.384E-03	2.956E-06	1.774E-05	1.802E-	2.235E-06	6.704E-06	3.119E-04	3.868E-07	1.160E-06
Striped dolphin	2.92E-02	2.384E-03	6.961E-05	4.177E-04	1.802E-	5.262E-05	1.579E-04	3.119E-04	9.107E-06	2.732E-05
Green sea turtle	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Kemp's Ridley sea turtle	1.71E-04	2.384E-03	4.076E-07	2.446E-06	1.802E-	3.082E-07	9.245E-07	3.119E-04	5.333E-08	1.600E-07
Leatherback sea turtle	1.88E-03	2.384E-03	4.482E-06	2.689E-05	1.802E-	3.388E-06	1.016E-05	3.119E-04	5.864E-07	1.759E-06
Loggerhead sea turtle	5.25E-02	2.384E-03	1.252E-04	7.509E-04	1.802E-	9.462E-05	2.838E-04	3.119E-04	1.637E-05	4.912E-05
		Totals:	0.001285	0.007711		0.000972	0.002915		0.000168	0.000504

TABLE B-2
ANIMALS AT RISK IN THE ATLANTIC OCEAN (Continued)

HIGH (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (3/yr)	Area (sq km)	One	Total	One	All
Atlantic spotted dolphin	3.530E-05	4.518E-08	1.356E-07	5.294E-04	6.776E-07	8.132E-06	6.480E-06	3.469E-05
Atlantic white-sided dolphin	3.530E-05	4.201E-07	1.260E-06	5.294E-04	6.300E-06	7.560E-05	6.025E-05	3.225E-04
Blue whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Bottlenose dolphin	3.530E-05	1.620E-06	4.861E-06	5.294E-04	2.430E-05	2.916E-04	2.324E-04	1.244E-03
Common dolphin	3.530E-05	6.283E-06	1.885E-05	5.294E-04	9.423E-05	1.131E-03	9.012E-04	4.825E-03
Cuvier's beaked whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Dwarf sperm whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Fin whale	3.530E-05	4.342E-07	1.303E-06	5.294E-04	6.512E-06	7.814E-05	6.227E-05	3.334E-04
Harbor porpoise	3.530E-05	5.507E-08	1.652E-07	5.294E-04	8.259E-07	9.910E-06	7.898E-06	4.228E-05
Humpback whale	3.530E-05	1.758E-08	5.274E-08	5.294E-04	2.636E-07	3.164E-06	2.521E-06	1.350E-05
Long-finned pilot whale	3.530E-05	2.298E-06	6.894E-06	5.294E-04	3.446E-05	4.136E-04	3.296E-04	1.764E-03
Mesoplodon spp. beaked whales	3.530E-05	1.490E-08	4.469E-08	5.294E-04	2.234E-07	2.681E-06	2.136E-06	1.144E-05
Minke whale	3.530E-05	1.956E-08	5.867E-08	5.294E-04	2.933E-07	3.519E-06	2.805E-06	1.502E-05
North Atlantic right whale	3.530E-05	9.778E-09	2.933E-08	5.294E-04	1.466E-07	1.760E-06	1.402E-06	7.508E-06
Pygmy killer whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Pygmy sperm whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Risso's dolphin	3.530E-05	2.471E-06	7.413E-06	5.294E-04	3.706E-05	4.447E-04	3.544E-04	1.897E-03
Sei whale	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Short-finned pilot whale	3.530E-05	2.298E-06	6.894E-06	5.294E-04	3.446E-05	4.136E-04	3.296E-04	1.764E-03
Sperm whale	3.530E-05	4.377E-08	1.313E-07	5.294E-04	6.565E-07	7.877E-06	6.278E-06	3.361E-05
Striped dolphin	3.530E-05	1.031E-06	3.092E-06	5.294E-04	1.546E-05	1.855E-04	1.478E-04	7.914E-04
Green sea turtle	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Kemp's Ridley sea turtle	3.530E-05	6.036E-09	1.811E-08	5.294E-04	9.053E-08	1.086E-06	8.657E-07	4.635E-06
Leatherback sea turtle	3.530E-05	6.636E-08	1.991E-07	5.294E-04	9.953E-07	1.194E-05	9.518E-06	5.096E-05
Loggerhead sea turtle	3.530E-05	1.853E-06	5.560E-06	5.294E-04	2.779E-05	3.335E-04	2.658E-04	1.423E-03
	Totals:	0.000019	0.000057		0.000285	0.003425	0.002729	0.014611

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN
SMALL LAND (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area (sq km)	One Component	Total (3/yr)	Area (sq km)	One	Total (3/yr)	Area (sq km)	One Component	Total
Beaked whales	1.50E-03	2.554E-04	3.831E-07	1.149E-06	2.470E-04	3.705E-07	1.112E-06	2.321E-05	3.482E-08	1.044E-07
Blue whale	1.00E-04	2.554E-04	2.554E-08	7.662E-08	2.470E-04	2.470E-08	7.410E-08	2.321E-05	2.321E-09	6.963E-09
Bottlenose dolphin	1.23E-02	2.554E-04	3.141E-06	9.424E-06	2.470E-04	3.038E-06	9.114E-06	2.321E-05	2.855E-07	8.564E-07
Common dolphin	1.16E+00	2.554E-04	2.954E-04	8.863E-04	2.470E-04	2.857E-04	8.572E-04	2.321E-05	2.685E-05	8.055E-05
Dall's porpoise	3.20E-02	2.554E-04	8.173E-06	2.452E-05	2.470E-04	7.904E-06	2.371E-05	2.321E-05	7.427E-07	2.228E-06
Fin whale	2.00E-04	2.554E-04	5.108E-08	1.532E-07	2.470E-04	4.940E-08	1.482E-07	2.321E-05	4.642E-09	1.393E-08
Gray whale	1.08E-02	2.554E-04	2.758E-06	8.275E-06	2.470E-04	2.668E-06	8.003E-06	2.321E-05	2.507E-07	7.520E-07
Harbor porpoise	6.00E-03	2.554E-04	1.532E-06	4.597E-06	2.470E-04	1.482E-06	4.446E-06	2.321E-05	1.393E-07	4.178E-07
Humpback whale	1.20E-03	2.554E-04	3.065E-07	9.194E-07	2.470E-04	2.964E-07	8.892E-07	2.321E-05	2.785E-08	8.356E-08
Killer whale	2.00E-04	2.554E-04	5.108E-08	1.532E-07	2.470E-04	4.940E-08	1.482E-07	2.321E-05	4.642E-09	1.393E-08
Minke whale	3.00E-04	2.554E-04	7.662E-08	2.299E-07	2.470E-04	7.410E-08	2.223E-07	2.321E-05	6.963E-09	2.089E-08
North right whale	1.00E-04	2.554E-04	2.554E-08	7.662E-08	2.470E-04	2.470E-08	7.410E-08	2.321E-05	2.321E-09	6.963E-09
North right whale dolphin	8.07E-02	2.554E-04	2.061E-05	6.183E-05	2.470E-04	1.993E-05	5.980E-05	2.321E-05	1.873E-06	5.619E-06
Pacific white-sided dolphin	4.61E-01	2.554E-04	1.176E-04	3.528E-04	2.470E-04	1.137E-04	3.412E-04	2.321E-05	1.069E-05	3.206E-05
Risso's dolphin	1.23E-01	2.554E-04	3.129E-05	9.386E-05	2.470E-04	3.026E-05	9.077E-05	2.321E-05	2.843E-06	8.530E-06
Sperm whale	3.40E-03	2.554E-04	8.684E-07	2.605E-06	2.470E-04	8.398E-07	2.519E-06	2.321E-05	7.891E-08	2.367E-07
		Totals:		0.000482		0.001447		0.000466		0.000044
										0.000132

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN
SMALL LAND (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (3/yr)	Area (sq km)	One Fairing	Total (9/yr)	One	All
Beaked whales	5.622E-06	8.433E-09	2.530E-08	9.312E-06	1.397E-08	1.257E-07	8.108E-07	2.516E-06
Blue whale	5.622E-06	5.622E-10	1.687E-09	9.312E-06	9.312E-10	8.381E-09	5.405E-08	1.678E-07
Bottlenose dolphin	5.622E-06	6.915E-08	2.075E-07	9.312E-06	1.145E-07	1.031E-06	6.649E-06	2.063E-05
Common dolphin	5.622E-06	6.504E-06	1.951E-05	9.312E-06	1.077E-05	9.695E-05	6.253E-04	1.941E-03
Dall's porpoise	5.622E-06	1.799E-07	5.397E-07	9.312E-06	2.980E-07	2.682E-06	1.730E-05	5.368E-05
Fin whale	5.622E-06	1.124E-09	3.373E-09	9.312E-06	1.862E-09	1.676E-08	1.081E-07	3.355E-07
Gray whale	5.622E-06	6.072E-08	1.822E-07	9.312E-06	1.006E-07	9.051E-07	5.838E-06	1.812E-05
Harbor porpoise	5.622E-06	3.373E-08	1.012E-07	9.312E-06	5.587E-08	5.028E-07	3.243E-06	1.007E-05
Humpback whale	5.622E-06	6.746E-09	2.024E-08	9.312E-06	1.117E-08	1.006E-07	6.487E-07	2.013E-06
Killer whale	5.622E-06	1.124E-09	3.373E-09	9.312E-06	1.862E-09	1.676E-08	1.081E-07	3.355E-07
Minke whale	5.622E-06	1.687E-09	5.060E-09	9.312E-06	2.794E-09	2.514E-08	1.622E-07	5.033E-07
North right whale	5.622E-06	5.622E-10	1.687E-09	9.312E-06	9.312E-10	8.381E-09	5.405E-08	1.678E-07
North right whale dolphin	5.622E-06	4.537E-07	1.361E-06	9.312E-06	7.515E-07	6.763E-06	4.362E-05	1.354E-04
Pacific white-sided dolphin	5.622E-06	2.589E-06	7.767E-06	9.312E-06	4.288E-06	3.859E-05	2.489E-04	7.725E-04
Risso's dolphin	5.622E-06	6.887E-07	2.066E-06	9.312E-06	1.141E-06	1.027E-05	6.622E-05	2.055E-04
Sperm whale	5.622E-06	1.911E-08	5.734E-08	9.312E-06	3.166E-08	2.849E-07	1.838E-06	5.704E-06
	Totals:	0.000011	0.000032		0.000018	0.000158	0.001021	0.003168

SMALL AIR (1998)

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2		
		Area	One	Total (0/yr)	Area	One	Total (3/yr)	Area	One	Total (3/yr)
Beaked whales	1.50E-03	--	--	--	2.470E-04	3.705E-07	1.112E-06	3.993E-05	5.990E-08	1.797E-07
Blue whale	1.00E-04	--	--	--	2.470E-04	2.470E-08	7.410E-08	3.993E-05	3.993E-09	1.198E-08
Bottlenose dolphin	1.23E-02	--	--	--	2.470E-04	3.038E-06	9.114E-06	3.993E-05	4.911E-07	1.473E-06
Common dolphin	1.16E+00	--	--	--	2.470E-04	2.857E-04	8.572E-04	3.993E-05	4.619E-05	1.386E-04
Dall's porpoise	3.20E-02	--	--	--	2.470E-04	7.904E-06	2.371E-05	3.993E-05	1.278E-06	3.833E-06
Fin whale	2.00E-04	--	--	--	2.470E-04	4.940E-08	1.482E-07	3.993E-05	7.986E-09	2.396E-08
Gray whale	1.08E-02	--	--	--	2.470E-04	2.668E-06	8.003E-06	3.993E-05	4.312E-07	1.294E-06
Harbor porpoise	6.00E-03	--	--	--	2.470E-04	1.482E-06	4.446E-06	3.993E-05	2.396E-07	7.187E-07
Humpback whale	1.20E-03	--	--	--	2.470E-04	2.964E-07	8.892E-07	3.993E-05	4.792E-08	1.437E-07
Killer whale	2.00E-04	--	--	--	2.470E-04	4.940E-08	1.482E-07	3.993E-05	7.986E-09	2.396E-08
Minke whale	3.00E-04	--	--	--	2.470E-04	7.410E-08	2.223E-07	3.993E-05	1.198E-08	3.594E-08
North right whale	1.00E-04	--	--	--	2.470E-04	2.470E-08	7.410E-08	3.993E-05	3.993E-09	1.198E-08
North right whale dolphin	8.07E-02	--	--	--	2.470E-04	1.993E-05	5.980E-05	3.993E-05	3.222E-06	9.667E-06
Pacific white-sided dolphin	4.61E-01	--	--	--	2.470E-04	1.137E-04	3.412E-04	3.993E-05	1.839E-05	5.516E-05
Risso's dolphin	1.23E-01	--	--	--	2.470E-04	3.026E-05	9.077E-05	3.993E-05	4.891E-06	1.467E-05
Sperm whale	3.40E-03	--	--	--	2.470E-04	8.398E-07	2.519E-06	3.993E-05	1.358E-07	4.073E-07
		Totals:	0.000000	0.000000		0.000466	0.001399		0.000075	0.000226

SMALL AIR (1998)

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)

Marine Mammal	Stage3			Payload Fairing			Total Across Species	
	Area	One	Total (3/yr)	Area	One	Total (9/yr)	One	All
Beaked whales	5.622E-06	8.433E-09	2.530E-08	6.133E-05	9.200E-08	8.280E-07	5.308E-07	2.144E-06
Blue whale	5.622E-06	5.622E-10	1.687E-09	6.133E-05	6.133E-09	5.520E-08	3.539E-08	1.430E-07
Bottlenose dolphin	5.622E-06	6.915E-08	2.075E-07	6.133E-05	7.544E-07	6.789E-06	4.353E-06	1.758E-05
Common dolphin	5.622E-06	6.504E-06	1.951E-05	6.133E-05	7.095E-05	6.385E-04	4.094E-04	1.654E-03
Dall's porpoise	5.622E-06	1.799E-07	5.397E-07	6.133E-05	1.963E-06	1.766E-05	1.132E-05	4.575E-05
Fin whale	5.622E-06	1.124E-09	3.373E-09	6.133E-05	1.227E-08	1.104E-07	7.078E-08	2.859E-07
Gray whale	5.622E-06	6.072E-08	1.822E-07	6.133E-05	6.624E-07	5.961E-06	3.822E-06	1.544E-05
Harbor porpoise	5.622E-06	3.373E-08	1.012E-07	6.133E-05	3.680E-07	3.312E-06	2.123E-06	8.578E-06
Humpback whale	5.622E-06	6.746E-09	2.024E-08	6.133E-05	7.360E-08	6.624E-07	4.247E-07	1.716E-06
Killer whale	5.622E-06	1.124E-09	3.373E-09	6.133E-05	1.227E-08	1.104E-07	7.078E-08	2.859E-07
Minke whale	5.622E-06	1.687E-09	5.060E-09	6.133E-05	1.840E-08	1.656E-07	1.062E-07	4.289E-07
North right whale	5.622E-06	5.622E-10	1.687E-09	6.133E-05	6.133E-09	5.520E-08	3.539E-08	1.430E-07
North right whale dolphin	5.622E-06	4.537E-07	1.361E-06	6.133E-05	4.949E-06	4.454E-05	2.856E-05	1.154E-04
Pacific white-sided dolphin	5.622E-06	2.589E-06	7.767E-06	6.133E-05	2.824E-05	2.542E-04	1.630E-04	6.583E-04
Risso's dolphin	5.622E-06	6.887E-07	2.066E-06	6.133E-05	7.513E-06	6.762E-05	4.335E-05	1.751E-04
Sperm whale	5.622E-06	1.911E-08	5.734E-08	6.133E-05	2.085E-07	1.877E-06	1.203E-06	4.861E-06
	Totals:	0.000011	0.000032		0.000116	0.001042	0.000668	0.002700

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)
MEDIUM/INTERMEDIATE (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2			
		Area	One	Total (144/yr)	Area	One	Total	Area	One	Total (16/yr)	
Beaked whales	1.50E-03	5.269E-04	7.904E-07	1.138E-04	2.138E-03	3.206E-06	5.130E-05	1.121E-04	1.682E-07	2.690E-06	
Blue whale	1.00E-04	5.269E-04	5.269E-08	7.587E-06	2.138E-03	2.138E-07	3.420E-06	1.121E-04	1.121E-08	1.794E-07	
Bottlenose dolphin	1.23E-02	5.269E-04	6.481E-06	9.332E-04	2.138E-03	2.629E-05	4.207E-04	1.121E-04	1.379E-06	2.206E-05	
Common dolphin	1.16E+00	5.269E-04	6.095E-04	8.777E-02	2.138E-03	2.473E-03	3.956E-02	1.121E-04	1.297E-04	2.075E-03	
Dall's porpoise	3.20E-02	5.269E-04	1.686E-05	2.428E-03	2.138E-03	6.840E-05	1.094E-03	1.121E-04	3.587E-06	5.740E-05	
Fin whale	2.00E-04	5.269E-04	1.054E-07	1.517E-05	2.138E-03	4.275E-07	6.840E-06	1.121E-04	2.242E-08	3.587E-07	
Gray whale	1.08E-02	5.269E-04	5.691E-06	8.194E-04	2.138E-03	2.309E-05	3.694E-04	1.121E-04	1.211E-06	1.937E-05	
Harbor porpoise	6.00E-03	5.269E-04	3.161E-06	4.552E-04	2.138E-03	1.283E-05	2.052E-04	1.121E-04	6.726E-07	1.076E-05	
Humpback whale	1.20E-03	5.269E-04	6.323E-07	9.105E-05	2.138E-03	2.565E-06	4.104E-05	1.121E-04	1.345E-07	2.152E-06	
Killer whale	2.00E-04	5.269E-04	1.054E-07	1.517E-05	2.138E-03	4.275E-07	6.840E-06	1.121E-04	2.242E-08	3.587E-07	
Minke whale	3.00E-04	5.269E-04	1.581E-07	2.276E-05	2.138E-03	6.413E-07	1.026E-05	1.121E-04	3.363E-08	5.381E-07	
North right whale	1.00E-04	5.269E-04	5.269E-08	7.587E-06	2.138E-03	2.138E-07	3.420E-06	1.121E-04	1.121E-08	1.794E-07	
North right whale dolphin	8.07E-02	5.269E-04	4.252E-05	6.123E-03	2.138E-03	1.725E-04	2.760E-03	1.121E-04	9.046E-06	1.447E-04	
Pacific white-sided dolphin	4.61E-01	5.269E-04	2.426E-04	3.494E-02	2.138E-03	9.843E-04	1.575E-02	1.121E-04	5.162E-05	8.260E-04	
Risso's dolphin	1.23E-01	5.269E-04	6.455E-05	9.295E-03	2.138E-03	2.618E-04	4.190E-03	1.121E-04	1.373E-05	2.197E-04	
Sperm whale	3.40E-03	5.269E-04	1.791E-06	2.580E-04	2.138E-03	7.268E-06	1.163E-04	1.121E-04	3.811E-07	6.098E-06	
		Totals:		0.000995	0.143295		0.004037	0.064590		0.000212	0.003387

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)
MEDIUM/INTERMEDIATE (1998)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (16/yr)	Area (sq km)	One	Total	One	All
Beaked whales	1.310E-05	1.965E-08	3.144E-07	1.972E-04	2.958E-07	1.420E-05	4.480E-06	1.823E-04
Blue whale	1.310E-05	1.310E-09	2.096E-08	1.972E-04	1.972E-08	9.466E-07	2.987E-07	1.215E-05
Bottlenose dolphin	1.310E-05	1.611E-07	2.578E-06	1.972E-04	2.426E-06	1.164E-04	3.674E-05	1.495E-03
Common dolphin	1.310E-05	1.515E-05	2.425E-04	1.972E-04	2.281E-04	1.095E-02	3.455E-03	1.406E-01
Dall's porpoise	1.310E-05	4.192E-07	6.707E-06	1.972E-04	6.310E-06	3.029E-04	9.558E-05	3.889E-03
Fin whale	1.310E-05	2.620E-09	4.192E-08	1.972E-04	3.944E-08	1.893E-06	5.974E-07	2.431E-05
Gray whale	1.310E-05	1.415E-07	2.264E-06	1.972E-04	2.130E-06	1.022E-04	3.226E-05	1.313E-03
Harbor porpoise	1.310E-05	7.860E-08	1.258E-06	1.972E-04	1.183E-06	5.679E-05	1.792E-05	7.293E-04
Humpback whale	1.310E-05	1.572E-08	2.515E-07	1.972E-04	2.366E-07	1.136E-05	3.584E-06	1.459E-04
Killer whale	1.310E-05	2.620E-09	4.192E-08	1.972E-04	3.944E-08	1.893E-06	5.974E-07	2.431E-05
Minke whale	1.310E-05	3.930E-09	6.288E-08	1.972E-04	5.916E-08	2.840E-06	8.960E-07	3.646E-05
North right whale	1.310E-05	1.310E-09	2.096E-08	1.972E-04	1.972E-08	9.466E-07	2.987E-07	1.215E-05
North right whale dolphin	1.310E-05	1.057E-06	1.691E-05	1.972E-04	1.591E-05	7.639E-04	2.410E-04	9.808E-03
Pacific white-sided dolphin	1.310E-05	6.033E-06	9.652E-05	1.972E-04	9.081E-05	4.359E-03	1.375E-03	5.597E-02
Risso's dolphin	1.310E-05	1.605E-06	2.568E-05	1.972E-04	2.416E-05	1.160E-03	3.659E-04	1.489E-02
Sperm whale	1.310E-05	4.454E-08	7.126E-07	1.972E-04	6.705E-07	3.218E-05	1.016E-05	4.132E-04
	Totals:	0.000025	0.000396		0.000372	0.017877	0.005641	0.229545

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)

HIGH (1998)

Marine Mammal	Density	Stage 0			Stage 1			Stage 2			
		Area (sq km)	One Component	Total (8/yr)	Area (sq km)	One Component	Total (4/yr)	Area (sq km)	One Component	Total (4/yr)	
Beaked whales	1.50E-03	2.384E-03	3.576E-06	2.861E-05	1.802E-03	2.703E-06	1.081E-05	3.119E-04	4.679E-07	1.871E-06	
Blue whale	1.00E-04	2.384E-03	2.384E-07	1.907E-06	1.802E-03	1.802E-07	7.209E-07	3.119E-04	3.119E-08	1.248E-07	
Bottlenose dolphin	1.23E-02	2.384E-03	2.932E-05	2.346E-04	1.802E-03	2.217E-05	8.867E-05	3.119E-04	3.836E-06	1.535E-05	
Common dolphin	1.16E+00	2.384E-03	2.758E-03	2.206E-02	1.802E-03	2.085E-03	8.339E-03	3.119E-04	3.608E-04	1.443E-03	
Dall's porpoise	3.20E-02	2.384E-03	7.628E-05	6.103E-04	1.802E-03	5.767E-05	2.307E-04	3.119E-04	9.981E-06	3.992E-05	
Fin whale	2.00E-04	2.384E-03	4.768E-07	3.814E-06	1.802E-03	3.604E-07	1.442E-06	3.119E-04	6.238E-08	2.495E-07	
Gray whale	1.08E-02	2.384E-03	2.575E-05	2.060E-04	1.802E-03	1.946E-05	7.786E-05	3.119E-04	3.369E-06	1.347E-05	
Harbor porpoise	6.00E-03	2.384E-03	1.430E-05	1.144E-04	1.802E-03	1.081E-05	4.325E-05	3.119E-04	1.871E-06	7.486E-06	
Humpback whale	1.20E-03	2.384E-03	2.861E-06	2.289E-05	1.802E-03	2.163E-06	8.651E-06	3.119E-04	3.743E-07	1.497E-06	
Killer whale	2.00E-04	2.384E-03	4.768E-07	3.814E-06	1.802E-03	3.604E-07	1.442E-06	3.119E-04	6.238E-08	2.495E-07	
Minke whale	3.00E-04	2.384E-03	7.152E-07	5.721E-06	1.802E-03	5.407E-07	2.163E-06	3.119E-04	9.357E-08	3.743E-07	
North right whale	1.00E-04	2.384E-03	2.384E-07	1.907E-06	1.802E-03	1.802E-07	7.209E-07	3.119E-04	3.119E-08	1.248E-07	
North right whale dolphin	8.07E-02	2.384E-03	1.924E-04	1.539E-03	1.802E-03	1.454E-04	5.818E-04	3.119E-04	2.517E-05	1.007E-04	
Pacific white-sided dolphin	4.61E-01	2.384E-03	1.098E-03	8.782E-03	1.802E-03	8.299E-04	3.320E-03	3.119E-04	1.436E-04	5.745E-04	
Risso's dolphin	1.23E-01	2.384E-03	2.920E-04	2.336E-03	1.802E-03	2.208E-04	8.831E-04	3.119E-04	3.821E-05	1.528E-04	
Sperm whale	3.40E-03	2.384E-03	8.105E-06	6.484E-05	1.802E-03	6.127E-06	2.451E-05	3.119E-04	1.060E-06	4.242E-06	
		Totals:		0.004502	0.036018		0.003404	0.013615		0.000589	0.002356

HIGH (1998)

TABLE B-3
ANIMALS AT RISK IN THE PACIFIC OCEAN (Continued)

Marine Mammal	Stage 3			Payload Fairing			Total Across Species	
	Area (sq km)	One Component	Total (4/yr)	Area (sq km)	One Fairing	Total (9/yr)	One	All
Beaked whales	3.530E-05	5.295E-08	2.118E-07	5.294E-04	7.941E-07	7.147E-06	7.594E-06	4.865E-05
Blue whale	3.530E-05	3.530E-09	1.412E-08	5.294E-04	5.294E-08	4.765E-07	5.063E-07	3.243E-06
Bottlenose dolphin	3.530E-05	4.342E-07	1.737E-06	5.294E-04	6.512E-06	5.860E-05	6.227E-05	3.989E-04
Common dolphin	3.530E-05	4.084E-05	1.633E-04	5.294E-04	6.124E-04	5.512E-03	5.857E-03	3.752E-02
Dall's porpoise	3.530E-05	1.130E-06	4.518E-06	5.294E-04	1.694E-05	1.525E-04	1.620E-04	1.038E-03
Fin whale	3.530E-05	7.060E-09	2.824E-08	5.294E-04	1.059E-07	9.529E-07	1.013E-06	6.487E-06
Gray whale	3.530E-05	3.812E-07	1.525E-06	5.294E-04	5.718E-06	5.146E-05	5.468E-05	3.503E-04
Harbor porpoise	3.530E-05	2.118E-07	8.472E-07	5.294E-04	3.176E-06	2.859E-05	3.038E-05	1.946E-04
Humpback whale	3.530E-05	4.236E-08	1.694E-07	5.294E-04	6.353E-07	5.718E-06	6.075E-06	3.892E-05
Killer whale	3.530E-05	7.060E-09	2.824E-08	5.294E-04	1.059E-07	9.529E-07	1.013E-06	6.487E-06
Minke whale	3.530E-05	1.059E-08	4.236E-08	5.294E-04	1.588E-07	1.429E-06	1.519E-06	9.730E-06
North right whale	3.530E-05	3.530E-09	1.412E-08	5.294E-04	5.294E-08	4.765E-07	5.063E-07	3.243E-06
North right whale dolphin	3.530E-05	2.849E-06	1.139E-05	5.294E-04	4.272E-05	3.845E-04	4.086E-04	2.617E-03
Pacific white-sided dolphin	3.530E-05	1.626E-05	6.502E-05	5.294E-04	2.438E-04	2.194E-03	2.331E-03	1.494E-02
Risso's dolphin	3.530E-05	4.324E-06	1.730E-05	5.294E-04	6.485E-05	5.837E-04	6.202E-04	3.973E-03
Sperm whale	3.530E-05	1.200E-07	4.801E-07	5.294E-04	1.800E-06	1.620E-05	1.721E-05	1.103E-04
	Totals:	0.000067	0.000267		0.001000	0.008998	0.009561	0.061254

TABLE B-4
ANIMALS AT RISK-ATLANTIC OCEAN

Rocket		Small Land	Small Air	Medium/ Intermediate	High	Total
Stage 0	One Component	0.000138	0	0.000284	0.001285	
	Total	0.000551	0	0.038345	0.007711	
Stage 1	One Component	0.000133	0.000133	0.001152	0.000972	
	Total	0.000533	0.000266	0.017284	0.002915	
Stage 2	One Component	0.000013	0.000022	0.00006	0.000168	
	Total	0.000005	0.000043	0.000906	0.000504	
Stage 3	One Component	0.000003	0.000003	0.000007	0.000019	
	Total	0.0000012	0.000006	0.000106	0.000057	
Payload Fairing	One Component	0.000005	0.000033	0.000106	0.000285	
	Total	0.000006	0.000198	0.004784	0.003425	
One Component Total		0.000291	0.000191	0.00161	0.002729	0.004821
All Components Total		0.001206	0.000514	0.061426	0.014611	0.077757

TABLE B-5
ANIMALS AT RISK-PACIFIC OCEAN

Rocket		Small Land	Small Air	Medium/ Intermediate	High	Total
Stage 0	One Component	0.000482	0	0.000995	0.004502	
	Total	0.001447	0	0.143295	0.036018	
Stage 1	One Component	0.000466	0.000466	0.004037	0.003404	
	Total	0.001399	0.001399	0.06459	0.013615	
Stage 2	One Component	0.000044	0.000075	0.000212	0.000589	
	Total	0.000132	0.000226	0.003387	0.002356	
Stage 3	One Component	0.000011	0.000011	0.000025	0.000067	
	Total	0.000032	0.000032	0.000396	0.000267	
Payload Fairing	One Component	0.000018	0.000116	0.000372	0.001	
	Total	0.000158	0.001042	0.017877	0.008998	
One Component Total		0.001021	0.000668	0.005641	0.009561	0.016891
All Components Total		0.003168	0.0027	0.229545	0.061254	0.296667